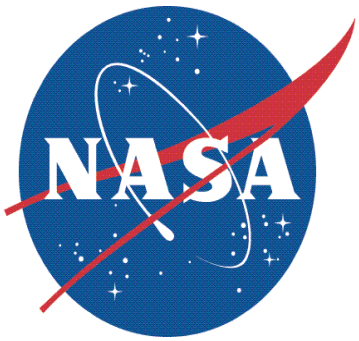
CHAPTER 1

PROGRAMMATIC PRESENTATIONS



JPL

Fundamental Physics Workshop Draws 85 to Solvang

The 2000 NASA/JPL Investigators' Workshop on Fundamental Physics took place in Solvang, Ca on June 19 to 21. The 85 attendees heard 33 oral presentations and saw18 poster presentations describing progress on research tasks that would benefit from the microgravity environment. Dr. Mark Lee of the Microgravity Research Division of NASA Headquarters described plans for reorganization of the microgravity research effort at HQs. As shown in his slides below, these plans show the intention to expand the Fundamental Physics discipline. Ulf Israelsson of JPL described recent changes in the organization of the Fundamental Physics program at JPL. He also delineated the plans for the release of an International Announcement of Opportunity for the microgravity disciplines. The National Space Development Agency of Japan was represented at this workshop by Hiruto Kobayashi. A summary of his talk, showing the organization of committees to direct NASDA's Fundamental Physics program, is included below in Chapter 1.

Also in the program, a special session heard plans for development of clocks for operation in microgravity, and attendees discussed ways that groups from France and the US who are developing such clocks can cooperate to their mutual benefits. Another special session was held to discuss experiments that might be flown on the Space Shuttle, especially during the period prior to the availability of the International Space Station.

One of the directions for expansion of the Fundamental Physics discipline is to add a new subdiscipline in Biological Physics. Xiawei Zhuang of Stanford presented a talk describing how single-molecule studies of paths for biological processes can observe the actual trajectories of individual molecules. The abstract for this talk is presented in Chapter 3. It is expected that a larger number of contributions in this subject area at the next workshop will reflect the growth of this subdiscipline.

Chapter 1 of the Proceedings contains this summary and the programmatic talks. Chapter 2 starts the scientific program, offering the papers, some represented by the abstracts, that were presented on Laser Cooled Atomic Physics. Chapter 3 has the abstract of the paper on Biological Physics by Dr. Zhuang. Chapter 4 continues the science papers with those covering Gravitational and Relativity Physics. Finally, Chapter 5 contains the papers and abstracts for the Low Temperature – Condensed Matter Physics subject area.

OFFICE OF LIFE & MICROGRAVITY SCIENCES AND APPLICATIONS

Overview of Microgravity Fundamental Physics Program

Presentation to:

2000 NASA/JPL International Conference on The Fundamental Physics in Space

June19-21, 2000
Solvang, California

Mark C. Lee
June 19, 2000

Status on NASA Fundamental Physics Program

- **Status of OLMSA**
- **Biological Force Sweeping through NASA**
- **New Look at the Role of Physical Sciences in Space**
- **Reorganization of NASA Microgravity Program**
  - **Different Forces**
  - **Recommended Organization: Division of Physical Sciences in Space (DPSS) to include Programs in Physical Sciences, Biomolecular Chemistry and Physics, Biotechnology & Earth-based Applications**
- **The Newly Organized Program will GROW and Fundamental Physics Program will be STRENGTHENED via our Strong Connections to Single Atoms and its Assembly Physics.**
- **Continuing Updating of the Fundamental Physics Program to include Biological Physics Discipline in the current Fundamental Physics NRA**
- **~20% growth in the FP PI's budget**
- **Status on LTMPF/M1&M2/LCAP/STEP**

Status on NASA Fundamental Physics Program continued...

- **The management responsibility of Alpha Magnetospectrometer (AMS) within NASA has been transferred to MRD.**

- **National Center for Microgravity Fundamental Physics**
  - **Cooperative Agreement Notice (CAN) will be released on June 26, 2000.**
  - **Proposal due on September 19, 2000**
  - **Award on or before December 29, 2000**

- **John Reppy was awarded NASA Distinguished Public Service Medal by NASA Administrator Mr. Daniel Goldin On June 15, 2000.**

Citation: "*For his dedicated support in stimulating and guiding the growth of the NASA Microgravity Fundamental Physics program in the past 15 years.*"

Fundamental Physics 00-HEDS-02

Sub-discipline	# Proposals
Biological Physics	13
Gravitational & Relativistic Physics	14
Laser Cooling & Atomic Physics	29
Low Temperature & Condensed Matter Physics	53
Total	109

Fundamental Physics Program Status

Presentation to:

2000 NASA/JPL International PI Meeting

Ulf Israelsson

June 19, 2000

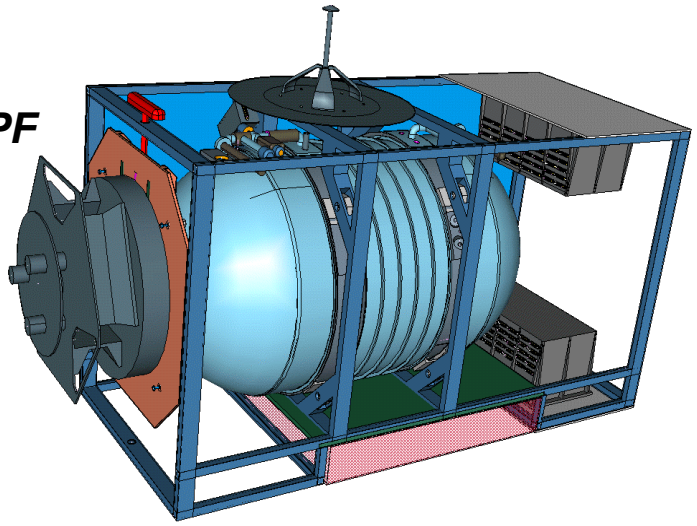
Program Status

Overview

- *Fundamental Physics has continued to expand slowly despite a difficult budget environment*
- *ISS schedule slips and budget pressure continue*
  - **Potential for new shuttle research missions**

Low Temperature/ Condensed Matter Physics

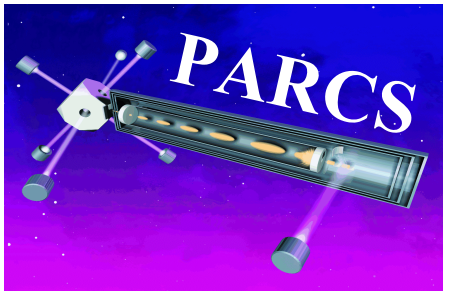
- *CVX-2 Candidate 2002 shuttle flight experiment*
- *MISTE and DYNAMX on first LTMPF flight*
- *BEST candidate for second LTMPF flight*
- *Cost growth experienced in development of LTMPF (more mature requirements, lack of ISS interface definition)*
- *Current budget marks supports development of only <u>one</u> multiple investigation facility*
- *First launch delayed 7 months until April 2005*
- *LTMPF launch cycle reduced from 16 month to every 22 months (28% flight reduction)*



Program Status

Laser Cooling and Atomic Physics

- *PARCS and RACE 'fully funded' but RACE launch later than desired*
- *Hardware funds for LCAP experiments selected from 2000 and 2001 NRAs not yet included*

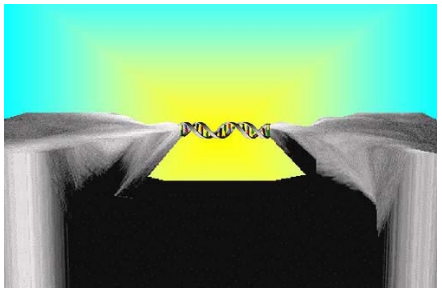


Gravitational Physics

- *STEP submitted as a SMEX proposal to Code S with Code UG, ESA, and European Laboratories funding commitment*
- *SUMO candidate for LTMPF second flight*

Biological Physics

- *Planned selection of pilot ground investigations from current NRA*
- *Plan to select flight experiments from future NRAs*
- *Biological Physics hardware development line for future flights not yet funded*



Jet Propulsion Laboratory
California Institute of Technology

ISS Fundamental Physics Traffic Model

MICROGRAVITY SCIENCE & APPLICATIONS

Microgravity Fundamental Physics Discipline ISS Flight Rate based on latest budget and ISS schedule

Steady State is 3 PIs/year (LIMPF = 3 PIs/22 mo; LCAP = 1 PI/18 months; BIO-P = 1 PI/18 months)

TOTAL thru FY16	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16
					LIMPF		LIMPF			LIMPF	LIMPF	LIMPF		LIMPF	LIMPF	LIMPF
Selections from Prior NRA: 91NRA = 1, 94NRA = 1, 96NRA = 4					1. 91NRA-1 Apr-05 DYNAMX Duncan		1. 96NRA-1 Feb-07 BEST-1 Ahlers/Liu		1. 01NRA-2 Dec-08 M3 TBD		1. 03NRA-2 Oct-10 M4 TBD	1. 05NRA-2 Aug-12 M5 TBD		1. 07NRA-2 Jun-14 M6 TBD		1. 09NRA-2 Apr-16 M7 TBD
LIMPF LT+ GRP 22					2. 94NRA-1 Apr-05 MISTE Barmatz		3. 96NRA-2 Feb-07 SUMO Lipa		2. 01NRA-3 Dec-08 M3 TBD		2. 03NRA-3 Oct-10 M4 TBD	2. 05NRA-3 Aug-12 M5 TBD		2. 07NRA-3 Jun-14 M6 TBD		2. 09NRA-3 Apr-16 M7 TBD
					1. 00NRA-1 Apr-05 M1-Guest1 TBD		4. 01NRA-1 Feb-07 M2-Guest TBD		3. 03NRA-1 Dec-08 M3-Guest TBD		3. 05NRA-1 Oct-10 M4-Guest TBD	3. 07NRA-1 Aug-12 M5-Guest TBD		3. 09NRA-1 Jun-14 M6-Guest TBD		3. 11NRA-1 Apr-16 M7-Guest TBD
					2. 00NRA-2 Apr-05 M1-Guest2 TBD											
ICAP 8					ICAP		ICAP	ICAP		ICAP	ICAP		ICAP	ICAP		ICAP
					1. 96NRA-3 Dec-04 PARCS Sullivan/Phillips		5. 96NRA-4 Nov-06 RACE Gibble	4. 00NRA-3 May-08 IC3 TBD		1. 01NRA-4 Nov-09 IC4 TBD	4. 03NRA-4 May-11 IC5 TBD		4. 05NRA-4 Nov-12 IC6 TBD	1. 07NRA-4 May-14 IC7 TBD		4. 09NRA-4 Nov-15 IC8 TBD
BIO-P 6								BIO-P		BIO-P	BIO-P		BIO-P	BIO-P		BIO-P
								5. 01NRA-5 Sep-08 BP1 TBD		4. 03NRA-5 Mar-10 BP2 TBD	1. 05NRA-5 Sep-11 BP3 TBD		4. 07NRA-5 Mar-13 BP4 TBD	4. 09NRA-5 Sep-14 BP5 TBD		1. 11NRA-2 Mar-16 BP6 TBD
TOTAL 36	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16
	0	0	0	0	5	0	4	2	3	2	5	3	2	5	0	5
TOTAL Selected	00NRA 4		01NRA 6		03NRA 8		05NRA 8		07NRA 8		09NRA 8		11NRA 8		13NRA 8	

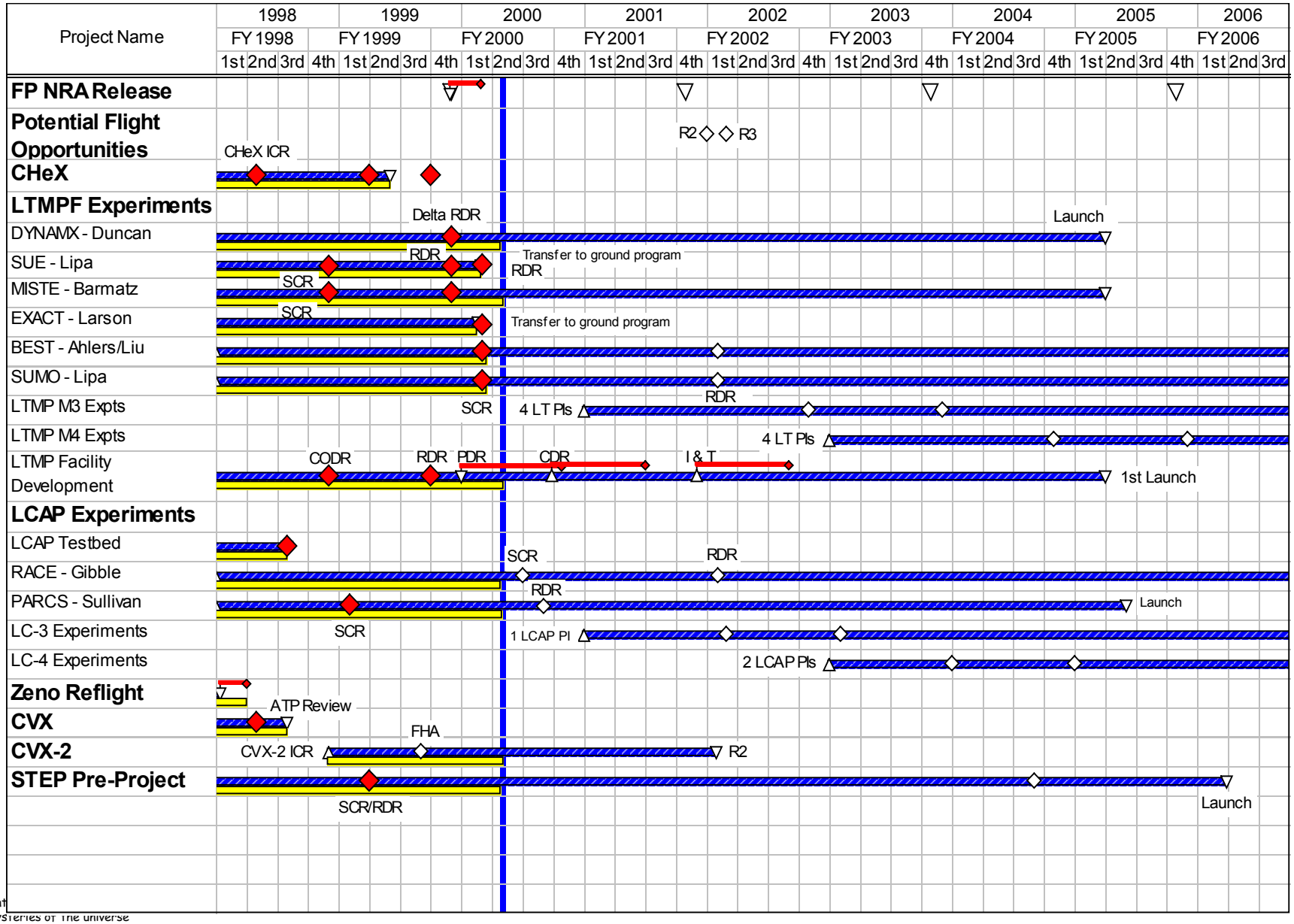
Exploring the frontiers of physics
to unlock the mysteries of the universe

JPL
Jet Propulsion Laboratory
California Institute of Technology

Fundamental Physics Program Schedule

Latest Revision: **May 3, 2000**

MICROGRAVITY SCIENCE & APPLICATIONS



Exploring the frontiers of space
to unlock the mysteries of the universe

Conclusions

- **Need to maintain vitality in the research program - striving to simply maintain status quo is risky at best**
  - **Explore new research directions in each sub-discipline**
  - **Pursue international collaborations (International AO)**
  - **Pursue collaborations with Code S**
- **Need investigators advocacy support**
  - **Outreach to public, NASA, and Congress**
  - **Relevance of science and technology**
  - **Weekly highlights are important**
- **Where we are currently pushing on the budget envelope**
  - **STEP collaboration**
  - **PARCS/RACE follow-on flight experiments**
  - **Second LTMPF facility**
  - **Biological Physics flight experiments**
- **There is a bright future ahead for the discipline, as soon as the ISS is fully up and running…...**

International Announcement of Opportunity

- To be released ~ August, 2000 by agency members of the International Microgravity Strategic Planning Group
  - NASA, ESA, NASDA, CSA, ASI, CNES, DLR
- Focus on flight experiments on the ISS in 2004 - 2006 timeframe using existing hardware
  - Shuttle research missions also a possibility
- Review Criteria
  - Scientific and Technical merit
  - Flight feasibility
  - Relevance to program of soliciting agency
  - Cost (NASA and CSA only)
- Each agency funds its own investigations although the selection process is coordinated by the IMSPG
- Fundamental Physics research hardware identified in solicitation
  - LTMPF and DYNAMX, MISTE, SUMO, BEST hardware
  - LCAP hardware
  - Glovebox
  - Misc. Fluids hardware

NASDA's study plan on fundamental physics in microgravity

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NASDA's study plan on fundamental physics started in 1997. Through discussions in a steering committee and subcommittees, microgravity experiments are promoted.

In 1997, the National Space Development Agency of Japan (NASDA) started 'study on fundamental physics in microgravity.' In order to show our originality, we determined the following areas to be studied mainly: low-temperature quantum liquids, critical point physics, and physical chemistry. In order to discuss details of subjects in each research area, we organized one committee and three subcommittees. In Tables 1-4, we show members of the steering committee and the three subcommittees. In Japan, microgravity experiments are not familiar to fundamental physicists. Thus one of the aims of the steering committee is to give information to Japanese scientists.

Chairman	Masuo Suzuki	Science University of Tokyo
Member	Kyozi Kawasaki	Chubu University
Member	Ryuji Takaki	Tokyo University of Agriculture and Technology
Member	Kazuo Kitahara	International Christian University
Member	Akira Onuki	Kyoto University
Member	Shin Takagi	Fuji Tokoha University

Table 1: Members of the steering committee of fundamental physics and chemistry.

Through discussions in the committees, NASDA's technical report [1] will be made on areas in which new scientific knowledge may be obtained through microgravity experiments. Based on the report and the discussions so far conducted, a research scenario will be open to the related scientific communities.

Every year the Japan Space Forum releases a Ground Research Announcement for ground-based research with the potential for microgravity experiments. The committee will define focused research areas in the fundamental physics discipline.

Chairman	Masuo Suzuki	Science University of Tokyo
Member	Shin Takagi	Fuji Tokoha University
Member	Takeo Satoh	Tohoku University
Member	Takao Mizusaki	Kyoto University

Member	Yuichi Okuda	Tokyo Institute of Technology
Member	Masahito Ueda	Tokyo Institute of Technology
Member	Masahide Murakami	Tsukuba University
Member	Makio Uwaha	Nagoya University

Table 2: Members of subcommittee of 'Low-Temperature Quantum Liquids.'

Chairman	Akira Onuki	Kyoto University
Member	Kyozi Kawasaki	Chubu University
Member	Hisao Azuma	Osaka Prefecture University
Member	Hajime Tanaka	Tokyo University
Member	Toru Maekawa	Toyo University
Member	Yuichi Miura	Nagoya University

Table 3: Members of subcommittee of 'Critical Point Physics.'

Chairman	Kazuo Kitahara	International Christian University
Member	Ryuji Takaki	Tokyo University of Agriculture and Technology
Member	Kenichi Yoshikawa	Kyoto University
Member	Masayasu Mimura	Hiroshima University
Member	Shoichi Kai	Kyushu University
Member	Shuko Fujieda	Ochanomizu University
Member	Shinya Koshihara	Tokyo Institute of Technology
Member	Hidetoshi Miike	Yamaguchi University
Member	Tomohiko Yamaguchi	Agency of Industrial Science and Technology
Member	Masami Kawaguchi	Mie University

Table 4: Members of subcommittee of 'Physical Chemistry.'

[1] M. Suzuki and H. Inokuchi, eds., *Fundamental Physics and Chemistry under Microgravity* (NASDA, Japan, 2000), to appear.